Mem. Qd Mus. 17(1): 63–7, pl. 2. [1974]

SOME ASPECTS OF REPRODUCTIVE BEHAVIOUR AND THE MALE ERECTILE ORGANS OF *DASYURUS GEOFFROII* AND *D. HALLUCATUS* (DASYURIDAE: MARSUPIALIA)

MICHAEL ARCHER
Queensland Museum

ABSTRACT

Male individuals of the marsupial species *Dasyurus geoffroii* and *D. hallucatus* have been kept live in captivity. Various types of sexual behaviour were observed. The erectile reproductive organs of both species, observed while the animals were asleep, are similar. In both there are two erectile structures, one evidently homologous with the penis of other mammals while the other is of uncertain homology. The male *D. geoffroii* was observed in courtship behaviour and an attempted copulation with a female. The peni of preserved specimens of *Sminthopsis leucopus*, a small dasyurid, have been dissected and found to differ from those of *Dasyurus geoffroii* and *D. hallucatus*.

Live dasyurids have been kept in captivity for five years as part of research into the diversity of this marsupial family. During this time various aspects of reproductive behavior and morphology were observed in Western Native Cats (*Dasyurus geoffroii*) Because these observations were made on captive individuals it is possible that some of the observed aspects of their reproductive behavior are unnatural. However, the morphology of the erectile structures of the males described below is clearly not affected by captivity.

DASYURUS GEOFROII

The male was obtained as a juvenile in July 1970. No sexual behaviour was observed until March 1971. At this time he was frequently observed to have an erection while asleep. By 17 March 1971 it was approximately 90 mm in length. On 23 April 1971 his brothers and sisters, held in cages in captivity by Miss V. Bristow, were mating. Miss Bristow noted (pers. com.) that copulation often lasted for three hours, with intermittent active thrusting by the males. A particular female copulated at least twice. No erections were observed in the male after April. On 10 March 1972 he was again observed to have an erection while asleep in a bureau drawer. The drawer was opened so that he could be observed. This opportunity lasted only a few moments after which he awoke and the erection subsided.

On 24 March 1972 he was presented with one of his sisters, with whom he had had no contact since July 1970. Her first reaction after being released into the living room of a house was to explore. After half an hour the male was released into the same room. She immediately hid beneath a bookcase. He located her by standing on his hind legs and sniffing

intently. Each effort brought him closer to her hiding place. Having discovered her, he stiffened, with his tail held out straight. He made nose to nose contact with the female, also tense and alert, and then with very uncharacteristic, steady and smooth movements, he made a determined effort to get close. She fled and he followed, staying about 30 cm behind. His movements actually resembled the stalking behaviour of placental cats but differed from his own behaviour when pursuing live prey. At first, when she stopped, he stopped. When she started off again, he followed again. After a few minutes of this type of pursuit, when she stopped, he came up to her flank and carefully sniffed. At first she turned and ran at him. He instantly drew back. Finally he approached her again but this time put a hand on her rump. She remained motionless. He did the same with his other hand and then pressed his chest against her rump. Suddenly she flipped on her back, opened her mouth, made a sharp noise and spread out her arms in an attack posture. He reacted by rearing up on his hind legs, threatening attack with sharp sounds, open mouth and outspread arms. They leaped apart, but in a moment he was again in pursuit as if nothing had happened. Hand-rump contact was again made. This time there was a continuous huffing by both individuals. The female, however, while huffing, raised her rump towards the male and set her throat down on the floor. She occasionally half-closed her eyes. In spite of this seeming acceptance, she refused to let him actually mount. At the last moment she flipped over and threatened. When this happened his tail quivered violently. He ran rapidly around the female apparently very tense. At no time during this evening did he appear to have an erection. Relations between the two appeared to degenerate and after two hours of this behaviour he bit the female's tail, drawing blood. After this she refused to raise her rump or make any obvious attempts to induce mating. They were separated to different rooms for the rest of the night.

The following evening they were again put together in the same room, but she indicated her unwillingness to have anything to do with him by attacking or continually hiding. They were again separated.

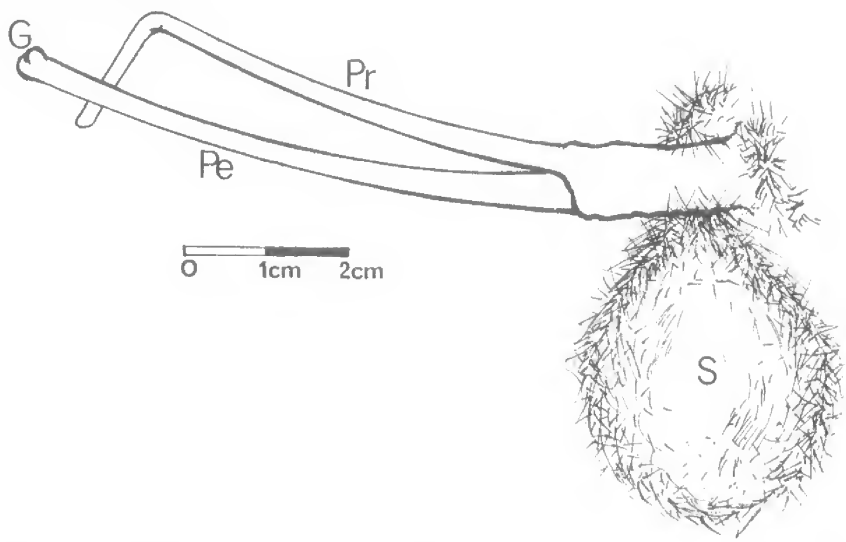

FIG. 1: Erectile reproductive organs of *Dasyurus geoffroii*. The dorsal structure (Pr) is only partially erect. The penis (Pe) is fully erect. The glans (G) and scrotum (S) are visible.

On 1 April 1972 another of the male's sisters, was put into the same room. She behaved in a manner very similar to the first female but appeared to be more interested in the male. When he followed her, she turned and chased him around the room. Several times she caught him and bit into his neck from above. He offered no resistance. After half an hour, he began to chase her. After catching her he grabbed the fur of her back with his hand and literally hauled her across the room to a secluded corner. He put her down and proceeded to mouth the thickened fur on the back of her neck. Both females had developed swollen necks at this time of year (a change noted by Miss V. Bristow, pers. comm., who held them in captivity for two years). Keeping his grip, the male mounted the second female. She remained quiet, with rump up and throat down. They stayed like this, not copulating for about three hours. His foot often vibrated against her leg. Several times he pulled her towards his abdomen with spasmodic jerks of his arms. These spasmodic jerks were highly regular in frequency, occurring every 1·5 seconds. These sessions lasted about one minute at a time with irregular pauses between. Ewer (1968) notes this type of behaviour in another dasyurid, *Sminthopsis crassicaudata*. After the first hour the male achieved a partially inflated erection (Fig. 1) but appeared unable to penetrate the vent. The female finally broke free. Mounting was not attempted again and he became aggressive, biting the female's tail. As a result they were separated.

Fig. 1 shows the erectile organs as noted while asleep. The intromittal penis has a slightly swollen glans, and a shaft. The other erectile structure emerges from near the base of the penis on its dorsal surface. Several times it was observed in full erection and it exceeded the ventral penis in length, the former reaching approximately 95 mm and the latter 90 mm. When both are inflated, they diverge. As a result it is difficult to envisage how they can both be intromittal organs. Although the male's attempt to mate was unsuccessful both organs were observed in partial erection while copulation was attempted (Plate 2B). The dorsal structure however was less rigid than the penis, and in fact when the animal was observed asleep, the dorsal structure was frequently only partially erect while the ventral penis was seemingly fully erect. Plate 2A shows the flaccid penal complex after it was physically pulled from the cloaca following death on 28 April 1973.

DASYURUS HALLUCATUS

A captive male was received on 1 July 1972. No sexual activity was observed until 9 July 1972, when he was observed, while sleeping, to have an erection. The erectile organs were identical to those of *D. geoffroii*.

SMINTHOPSIS LEUCOPUS

Preserved specimens of this species (e.g. Fisheries and Wildlife Department of Victoria D5343) have been examined and no evidence for an erectile structure dorsal to the penis was found. The glans was partly bifid at the tip. In the retracted state the penis exists in a pocket of the cloaca. When the glans is drawn out, the infolded pocket everts. The surface of the penal shaft was found to be covered by minute rough projections.

DISCUSSION

Descriptions of and remarks about the penis of dasyurids have been given by MacKenzie (1919), Sharman (1970), Fordham (1928), Gerhardt (1933), Jones (1949), and Marlow (1961). General observations on reproduction in dasyurids are given by Woolley (1966), Marlow (1961), Hill and O'Donoghue (1913), Fleay (1934, 1935a and b, 1940, 1961), Mack (1961), Ewer (1968), and Godfrey (1968).

Descriptions of and remarks about the penis of other marsupials have been given by Osgood (1921), Sharman (1970), Hartman (1921), MacKenzie (1919), Rotenburg and Glauert (1928), Young (1879) and Owen (1868). General studies on reproduction in marsupials are reviewed for example by Sharman, Calaby and Poole (1966), Sharman (1970), and Sharman and Calaby (1964).

Gerhardt (1933) illustrates the flaccid penis of *Dasyurus viverrinus* and indicates its complex structure. I can find no other description or suggestion of an erectile complex comparable with that reported here for *Dasyurus*. However, most of the studies noted above have been made on preserved specimens. Bifidy of the dasyurid glans is well-documented (e.g. Fordham, 1928) and it has been suggested that this corresponds to the two lateral vaginal horns (Hartman, 1922 and Sharman, 1970) of the female. However, the parts of the penal complex noted in the present study do not form a bilaterally symmetric pair and their total function is hence not so easily explained. The dorsal erectile organ in *Dasyurus* may be a modified prepuce, but this has not been satisfactorily determined. More work involving preserved specimens will be necessary to determine the homology of this dorsal structure.

ACKNOWLEDGEMENTS

I wish to thank my wife Elizabeth for patiently bringing up the male Western Native Cat for three years, Miss V. Bristow for allowing us the opportunity to raise the male, Mr R. Warneke for permission to examine specimens of *Sminthopsis* in his care, and Dr P. Woolley for kindly bringing Gerhardt's (1933) work to my attention and general comments on a draft of this work. While this research was carried out I was supported alternatively by a Fulbright Scholarship, a grant in aid from the American Explorer's Club and a Research Assistantship to Dr W. D. L. Ride, Director of the Western Australian Museum, who was in receipt of a Research Grant from the Australian Research Grants Committee.

LITERATURE CITED

EWER, R. F., 1968. A preliminary survey of the behaviour in captivity of the dasyurid marsupial, *Sminthopsis crassicaudata* (Gould). *Zeitschrift für Tierpsychologie* **25**: 319–65.

FLEAY, D., 1934. The brush-tailed phascogale. First record of breeding habits. *Victorian Naturalist* **51**: 88–100.

1935a. Breeding of *Dasyurus viverrinus* and general observations on the species. *Journal of Mammalogy* **16**: 10–16.

1935b. Notes on the breeding of Tasmanian devils. *Victorian Naturalist* **52**: 100–105.

1940. Breeding the tiger-cat. *Victorian Naturalist* **56**: 159–63.

1961. Breeding the mulgara. *Victorian Naturalist* **78**: 160–7.

FORDHAM, M. G. C., 1928. The anatomy of the urinogenital organs of the male *Myrmecobius fasciatus*. *Journal of Morphology* **46**: 563–83.

GERHARDT, U. VON, 1933. Kloake and Begattungsorgane b) Marsupialier, Beuteltiere. Pp. 318–21 *in* BOLK, L., GEPPERT, E., KALLIUS, E. and LUBOSCH, W. (Eds.) 'Handbuch der vergleichenden Anatomie der Wirbeltiere'. (Berlin).

GODFREY, G. K., 1969. Reproduction in a laboratory colony of the marsupial mouse *Sminthopsis larapinta* (Marsupialia: Dasyuridae). *Australian Journal of Zoology* **17**: 637–54.

HARTMAN, C., 1922. Breeding habits, development, and birth of the opossum. *Smithsonian Institution Annual Reports* **1921**: 347–63.

HILL, J. P. and O'DONOGHUE, C. H., 1913. The reproductive cycle of the marsupial *Dasyurus viverrinus*. *Quarterly Journal of Microscopical Science* **59**: 133–74.

JONES, F. W., 1949. The study of a generalized marsupial (*Dasycercus cristicauda* Krefft). *Transactions of the Zoological Society of London* **26**: 409–501.

MACKENZIE, W. C., 1919. 'The genito-urinary system in monotremes and marsupials'. Pp. 1–106. (Jenkin, Buxton and Co.: Melbourne).

MARLOW, B. J., 1961. Reproductive behaviour of the marsupial mouse, *Antechinus flavipes* (Waterhouse) (Marsupialia) and the development of the pouch young. *Australian Journal of Zoology* **9**: 203–18.

OSGOOD, W. H., 1921. A monographic study of the American marsupial, *Caenolestes*. *Field Museum of Natural History* (Zool.) **14**: 1–162.

OWEN, R., 1868. 'On the anatomy of Vertebrates. Vol. 3. Mammals', Pp. 1–915. (Longmans, Green, and Co.: London).

ROTENBERG, D., and GLAUERT, L., 1929. Notes on the male generative apparatus of *Tarsipes spenserae*. *Journal of the Royal Society of Western Australia* **15**: 9–14.

SHARMAN, G. B., 1970. Reproductive physiology of marsupials. *Science* **167**: 1221–8.

SHARMAN, G. B., and CALABY, J. H., 1964. Reproductive behaviour in the red kangaroo, *Megaleia rufa*, in captivity. *CSIRO Wildlife Research* **9**: 58–85.

SHARMAN, G. B., CALABY, J. H. and POOLE, W. E., 1966. Patterns of reproduction in female diprotodont marsupials. Pp. 205–32 *In* I. W. ROWLANDS (Ed.) 'Comparative Biology of Reproduction in Mammals' (Academic Press: London).

WOOLLEY, P., 1966. Reproduction in *Antechinus* spp. and other dasyurid marsupials. Pp. 281–94 *in* I. W. ROWLANDS (Ed.) 'Comparative Biology of Reproduction in Mammals' (Academic Press: London).

YOUNG, A. H., 1879. On the male generative organs of the Koala. (*Phascolarctos cinereus*). *Journal of Anatomy and Physiology* **13**: 305–17.